YIELD AND PROFITABILITY OF TARO PRODUCTION UNDER THREE WEED MANAGEMENT SCHEMES AT ROTA, COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

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Abstract

This experiment conducted at Sabana, Rota from October, 1990 to June, 1991 determined the yield and profitability of growing taro under three weed management schemes. These were weeding taro at 60 and 120 days after planting (low input), weeding taro at 30, 60, 90, and 120 days after planting (high input), and rototilling at 60 and 120 days after planting (farmer's practice).

Taro plants under high-input plots produced the highest yields and profits. The farmer's practice had the lowest yields and profits. However, the corms under farmer's practice were big and fully developed. This study could not single out the effects of weed management in taro yield under farmer's practice due to tillage and/or wide space of planting (90 cm between plants and 90 cm between rows) and the other treatments (60 cm between plants and 90 cm between rows).

Introduction

Weed control is a constraint in growing taro in the Commonwealth of the Northern Mariana Islands as identified in the Rapid Rural Appraisal survey conducted in January, 1990. Farmers adopt various weed control practices. Few farmers maintained farms weed free until harvest time. A majority of them allowed weeds to grow and weeded if necessary. No local study has been done on controlling weeds of taro. Therefore, this project aimed to determine the yield of taro and profits derived from different weed management practices.

Materials and Methods

A farmer-cooperator was selected based on his willingness to cooperate and volunteer his farm for this pursuit. This cooperator provided the planting materials (red taro) and his hired laborers to maintain the experiment. Technical assistance, fertilizer, and common pesticides were provided by the project.

The experiment used randomized complete block design with six replications. Three treatments were tested:

Low weed management = Weeding at 60 and 120 days after planting (DAP) (low input)

High weed management = weeding at 30, 60, 90, and 120 DAP (high input)

Farmers's weed management = rototilling at 60 and 120 DAP (farmer's practice)

Each treatment was composed of seven rows per replication. The inner five rows were utilized for obtaining samples for yield and for determining the hours spent on a plot basis for all possible farm operations. Eleven plants were planted in each row measuring 6 m long and 5.4 m wide. The distance of planting for low- and high-management plots was 60 cm between plants and 90 cm between rows. The farmer-cooperator used 90 cm between plants and rows. Except for the farmer's plots, the plots were fertilized with 16-16-16 at planting (1/2 tablespoon/plant) and at 90 and 150 DAP (1 tablespoon/plant).

All plots were sprayed with either Sevin or Malathion based on insect counts made biweekly for the ecology study. This study was superimposed in that experiment.

Taro plants were harvested eight months after planting. Taro corms were cleaned before determining yields.

To obtain profitability estimates, the following computations were done:

1. Income over variable costs = Gross income - total costs

   Where: Gross income = Total yield/ha x $/kg
   Total costs = Variable costs (e.g. chemicals, seeds, etc.) + fixed costs (e.g. machines, etc.)

2. Returns ($)
   a. Return to management = Gross income - total costs
   b. Return to labor and management = Return to management + labor cost
   c. Return to machinery and management = Return to management + machinery costs
   d. Return to material and management = Return to management + material cost

3. Break-even analysis
   a. Break-even yield (kg/ha) = $\frac{\text{Total cost of production/ha}}{\text{Average price/kg}}$
   b. Break-even price ($/kg) = $\frac{\text{Total cost of production/ha}}{\text{Average production/ha}}$

Results and Discussion

Yield

The difference in taro yields was highly significant among the weed management practices (Table 1). Taro plots hand weeded at 30, 60, 90, and 120 DAP produced the highest yields of 7,150 kg/ha. This yield was significantly different from plots hand weeded at 60 and 120 DAP. Farmer's practice of rototilling at 60 and 120 DAP had the lowest taro production. The cultivation done could have disturbed the root formation. The population density and lack of fertilization had effects on taro yields. The population from farmer's plots were only 12,346 plants/ha, while the other two treatments had 18,518 plants/ha. The weights of corms per plant were 250 g/plant, 386 g/plant, and 333 g/plant for low, high, and farmer's weed management schemes, respectively.

Table 1. Total yields of taro (kg/ha) under three weed management schemes at Sabana, Rota.

Weed management schemes[1]	Yield
Low-input	4,629.6
High-input	7,150.2
Farmer's practice	4,104.9
LSD .05	1,380.0
.01	2,280.0
CV	11.46

[1] Low-input - hand weeding at 60 and 120 days after taro planting; high-input - hand weeding at 30, 60, 90, and 120 days DAP; and farmer's practice - rototilling at 60 and 120 DAP.

Profitability Estimates

Machinery and Labor Requirements

Tables 2a, 2b, and 2c showed variation in the machine and labor requirements of low-input, high-input, and farmer's practice of weed management for taro. The farmer's practice utilized more man machine labor than the other treatments since he utilized a rototiller for controlling weeds. The high-input plots had high recorded man hours for weeding because there were two additional hand weeding activities.

Table 2a. Machinery and labor requirements by operation for low-input weed management (p/ha basis).

Operation	Machinery equipment hours	Labor (hrs) Skilled	Labor (hrs) Unskilled
Cutting preparation			
Pulling cuttings	-	-	7
Trimming cuttings	-	-	23
Dipping cuttings in chemicals	-	-	2
Land preparation			
Cleaning	17	-	-
Plowing	17	-	-
Planting			
Digging holes	-	-	17
Distributing seedlings	-	-	2
Planting	-	17	-
Fertilizing			
Basal	-	3	-
Side dressing	-	17	-
Weeding (manual)			
(2 times, 17 hrs/weeding)	-	-	34
Spraying			
(5 times, 13 hrs/spraying)	-	65	-
Harvesting			
Pulling plants	-	-	7
Cleaning corms	-	-	7
Total	34	102	99

Table 2b. Machinery and labor requirements by operations for high-input weed management (p/ha basis).

Operation	Machinery equipment hours	Labor (hrs) Skilled	Labor (hrs) Unskilled
Cutting preparation			
Pulling cuttings	-	-	7
Trimming cuttings	-	-	23
Dipping cuttings in chemicals	-	-	2
Land preparation			
Cleaning	17	-	-
Plowing	17	-	-
Planting			
Digging holes	-	-	17
Distributing seedlings	-	-	2
Planting	-	17	-
Fertilizing			
Basal	-	3	-
Side dressing	-	17	-
Weeding (manual)			
(4 times, 13 hrs/weeding)	-	-	52
Spraying			
(4 times, 13 hrs/spraying	-	65	-
Harvesting			
Pulling plants	-	-	6
Cleaning corms	-	-	10
Total	34	102	119

Table 2c. Machinery and labor requirements by operation for farmer's weed management (p/ha basis).

Operation	Machinery equipment hours	Labor (hrs) Skilled	Labor (hrs) Unskilled
Cutting preparation			
Pulling cuttings	-	-	7
Trimming cuttings	-	-	23
Dipping cuttings in chemicals	-	-	2
Land preparation			
Cleaning	17	-	-
Plowing	17	-	-
Planting			
Digging holes	-	-	17
Distributing seedlings	-	-	3
Planting	-	13	-
Fertilizing			
Basal	-	-	-
Side dressing	-	-	-
Rototilling			
(2 times, 10 hrs/rototilling)	20	-	-
Spraying			
(5 times, 10 hrs/spraying)	-	50	-
Harvesting			
Pulling plants	-	-	3
Cleaning corms	-	-	9
Total	54	63	64

Material Requirements

Due to the wider spacing used by the farmer, fewer cuttings and harvest materials were used for this treatment (Tables 3a, b, and c).

Table 3a. Material requirements by operation for low-input weed management (p/ha basis).

	Materials	Quantity	Unit price
Cutting preparation	Cormels	18,520 pieces	$0.01/piece
Spraying	Malathion or Sevin	5 pints	$4/pint
Fertilizing	16-16-16	11 bags (20 lb/bag)	$29/bag
Harvesting	Onion bags	93 pieces	$2/piece
	Racks	10 pieces	$20/rack

Table 3b. Material requirements by operation for high-input weed management (p/ha basis).

	Materials	Quantity	Unit price
Cutting preparation	Cormels	18,520 pieces	$0.01/piece
Spraying	Malathion or Sevin	5 pints	$4/pint
Fertilizing	16-16-16	11 bags (20 lb/bag)	$29/bag
Harvesting	Onion bags	150 pieces	$2/piece
	Racks	15 pieces	$20/rack

Table 3c. Material requirements by operation for farmer's weed management (p/ha basis).

	Materials	Quantity	Unit price
Cutting preparation	Cormels	12,350 pieces	$0.01/piece
Spraying	Malathion or Sevin	5 pints	$4/pint
Fertilizing	-	-	-
Harvesting	Onion bags	85 pieces	$2/piece
	Racks	8 pieces	$20/rack

Machinery and Equipment Cost

This cost was similar for all the weed management schemes (Table 4). For practical purposes, costs considered under this category were for oil/grease change, diesel fuel, and repairs on a yearly basis.

Table 4. Machinery and equipment cost calculations.

	Tractor	Attachments Plow	Mower	Disk	Rotovator
Horsepower	50	-	-	-	-
Market value	35,000	3,000	3,000	6,000	5,000
Annual use (hrs)	320	80	90	80	70
Use life (years)	20	15	-	-	-
Fuel type	Diesel	-	-	-	-
Annual service (Change oil and grease)	300	-	-	-	-
Diesel (30/months)	360	-	-	-	-
Repairs	500	100	-	200	150

Gross Receipts

Considering a fixed price per kg for all the harvests obtained from the three weed management practices, the high-input treatment had the highest gross receipts (Table 5). The low-input and farmer's practice had only a difference of $500.

Table 5. Gross receipts (based on a ha per crop).

Weed Management[1]	Quantity (kg/ha)	$/unit	Value ($)
Low input	4,629.6	$2.20/kg	10,185.12
High input	7,150.2	$2.20/kg	15,730.44
Farmer's practice	4,104.9	$2.20/kg	9,030.78

[1] Low input - hand weeding at 60 and 120 DAP; high input - hand weeding at 30, 60, 90, and 120 DAP; and farmer's practice of rototilling at 60 and 120 DAP.

Variable Expenses

The labor and material requirements constituted the variable expenses for all the treatments (Tables 6a, 6b, and 6c). The high-input plots had the highest expenses while the farmer's practice had the lowest. The high- and low-input plots differed at weeding and harvesting operations for costs. The high-input treatment incurred more expenses than the low-input plots. The farmer did not fertilize but spent more in utilizing a rototiller for weeding than other treatments.

Machinery and equipment cost found in Table 4 were included in the computation of total variable costs.

Table 6a. Variable expenses for low-input weed management of taro (on a per hectare basis).

Operation	Labor[1] ($)	Material	Subtotal
Seedling preparation	40.00	185.20	225.20
Land preparation	136.00	-	136.00
Planting	45.00	-	45.00
Fertilizing	25.00	319.00	344.00
Weeding	42.50	-	42.50
Spraying	81.25	20.00	101.25
Harvesting	17.50	386.00	403.50
Total	387.25	910.20	1,297.45

[1] $1.25/man hour; $4/man-machine hour

Table 6b. Variable expenses for high-input weed management of taro (on a per hectare basis).

Operation	Labor[1] ($)	Material	Subtotal
Seedling preparation	40.00	185.20	225.20
Land preparation	136.00	-	136.00
Planting	45.00	-	45.00
Fertilizing	25.00	319.00	344.00
Weeding	65.00	-	65.00
Spraying	81.25	20.00	101.25
Harvesting	20.00	600.00	620.00
Total	412.25	1,124.20	1,536.45

[1] $1.25/man hour; $4/man-machine hour

Table 6c. Variable expenses for farmer's weed management of taro (on a per hectare basis).

Operation	Labor[1] ($)	Material	Subtotal
Seedling preparation	40.00	123.50	163.50
Land preparation	136.00	-	136.00
Planting	41.25	-	41.25
Fertilizing	-	-	-
Weeding	80.00	-	80.00
Spraying	62.50	20.00	82.50
Harvesting	15.00	330.00	345.00
Total	374.75	473.50	848.25

[1] $1.25/man hour; $4/man-machine hour

Income and Returns

The approximated incomes for low-input, high-input, and farmer's practice of taro week management were $8,900, $14,200, and $8,200, respectively (Table 7). The returns to management and other expenses followed a similar trend as that of the income for the three weed practices. This means high-input and farmer's practice had the ranking of most to the least profitable, respectively.

Table 7. Summary budget (based on a per hectare basis).

Item	Low input Cost	%	High input Cost	%	Farmer's practice Cost	%
			($)			
Gross receipts	10,185.12	-	15,730.44	-	9,030.78	
Variable costs						
Labor	387.25	13.3	412.25	13.1	374.75	15.2
Machinery & equipment	1,610.00	55.4	1,610.00	51.2	1,610.00	65.5
Materials	910.20	31.3	1,124.20	35.7	473.50	19.3
Total	2,907.45		3,146.45		2,458.25	
Income over variable costs	7,277.67		12,583.99		6,572.53	
Return to management	7,277.67		12,996.24		6,572.53	
Return to labor and management	7,664.92		12,996.24		6,947.28	
Return to machinery and management	8,887.67		14,193.99		8,182.53	
Return to materials and management	8,187.87		13,708.19		7,046.03	

Break-Even Analysis

The break-even yields and prices for respective weed management schemes of taro are listed in Table 8. This information was useful in determining at what yield and price a farmer would be able to cover total costs of expenses and not incur losses.

Table 8. Break-even analysis.

Item	Low input	High input	Farmer's practice
Break-even yield (kg/ha)	1,321.57	1,430.20	1,117.39
Break-even price ($/kg)	0.63	0.44	0.60

Summary

Weeding taro at 30, 60, 90, and 120 DAP produced higher yields of taro than weeding or rototilling at 60 and 120 DAP. It seemed controlling weeds from the first four months of taro growth could reduce competition with weeds for space, moisture, light, and nutrients. Though the farmer's practice had the lowest yields, the corms were big and fully developed. This experiment, however, could not single out the effects of tillage and wide planting spaces.

The expenses incurred under high-input management were higher than the other practices. However, the income and returns derived from weeding at 30, 60, 90, and 120 days after planting were more promising than the other weed management schemes.

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